Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Amendment of Parts 1, 21, 73, 74 and 101 of the Commission's Rules to Facilitate the Provision of Fixed and Mobile Broadband Access, Educational and Other Advanced Services in the 2150-2162 and 2500-2690 MHz Bands	)	WT Docket No. 03-66 RM-11614
	)	

REPLY COMMENTS

July 22, 2011

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WIRELESS COMMUNICATIONS ASSOCIATION

The Wireless Communications Association International, Inc. ("WCAI"), the trade association of the wireless broadband industry, submits these reply comments in the Fourth Further Notice of Proposed Rulemaking ("NPRM") in this proceeding.[1]

I. Executive Summary

All 2.5 GHz licensees and the vast majority of equipment manufacturers commenting in the record support the Commission's proposal to amend the OOBE limits in the 2.5 GHz band. These commenters recognize that updated OOBE limits are necessary to realize the full benefits of 4G technologies in the 2.5 GHz band – the fastest throughput at the lowest cost. The few commenters who oppose the Commission's proposal rely on worst-case assumptions that do not account for the actual operating characteristics of 4G systems or the types of devices that face the most stringent form factor requirements. Based on the public interest benefits of the proposal and its overwhelming record support, the Commission should adopt the proposed rule as soon as practicable.

II. Discussion

a. The majority of commenters support the Commission's proposal to amend the OOBE limits in the 2.5 GHz band

The majority of commenters in this proceeding recognize the substantial benefits of amending the Commission's rules OOBE limits for mobile digital stations in the 2.5 GHz band to accommodate the use of the wider channel bandwidths.[2] These commenters agree

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[1]In the Matter of Wireless Communications Association Int'l Petition to Amend Section 27.53(m) of the Commission's Rules, Public Notice, RM-11614 (rel. Nov. 4, 2010).

[2] *See generally* Comments of Catholic Television Network and the National EBS Association, WT Docket No. 03-66 (filed July 7, 2011) ("CTN/NEBSA Comments"); Comments of Nokia Siemens Networks US LLC and Nokia Inc., WT Docket No. 03-66 (filed July 7, 2011) ("Nokia Siemens Comments"); Comments of GCT Semiconductor, WT Docket No. 03-66 (filed July 7, 2011); Comments of Clearwire Corp., WT Docket No. 03-66 (filed July 7, 2011); Comments of Motorola Mobility, Inc., WT Docket No. 03-66 (filed July 7, 2011) ("Motorola Comments"); Comments of

that the proposed changes "will advance key goals of the National Broadband Plan and better align the Commission's rules with current and future 4G standards."[3] They also agree that "the likelihood of heightened adjacent band interference is remote, and processes are already in place to handle any adjacent band interference issues."[4] The vast majority of 2.5 GHz licensees, as evidenced by the comments of WCAI, CTN/NEBSA, and MainStreet Broadband, also support the proposal and express no concerns regarding any potential for interference within the 2.5 GHz band.[5] This overwhelming record support demonstrates that the public interest would be best served by adoption of the rules as proposed by the Commission in the NPRM.

b. Amending the OOBE limits in the 2.5 GHz band would not cause harmful interference to Globalstar or BAS channels A10 and A9.

Globalstar objects to the proposed amendments to the OOBE limits in the 2.5 GHz band based on its concern that the amendment could result in interference in rural and remote areas.[6] The Engineers for the Integrity of Broadcast Auxiliary Services Spectrum ("EIBASS") similarly claim the amendment could result in increased interference to Broadcast Auxiliary Service ("BAS") Channels A9 and A10.[7] As demonstrated below, real-world experience with the co-channel coexistence of BRS/EBS operations with Globalstar's

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Huawei Technologies (USA), WT Docket No. 03-66 (filed July 7, 2011); SEQUANS Communications, WT Docket No. 03-66 (filed July 7, 2011); Alcatel-Lucent, WT Docket No. 03-66 (filed July 7, 2011); Main Street Broadband LLC, WT Docket No. 03-66 (filed July 7, 2011); Telecommunications Industry Association, WT Docket No. 03-66 (filed July 7, 2011) ("TIA Comments").

[3] Motorola Comments at 1-2.

[4] Nokia Siemens Comments at 3.

[5] Most BRS licensees are members of WCAI, and most EBS licensees are represented by the CTN/NEBSA Comments.

[6] Comments of Globalstar, WT Docket No. 03-66 (filed July 7, 2011) ("Globalstar Comments").

[7] Comments of EIBASS, WT Docket No. 03-66 (filed July 7, 2011) ("EIBASS Comments").

mobile satellite service ("MSS") and BAS demonstrates that the proposed amendment would not cause a noticeable impact to Globalstar or BAS channel A9 or A10 operations.

BRS-1 operates on a co-primary, co-channel basis with both Globalstar's MSS and BAS Channel A10. In the proceedings leading up to the rebanding of the 2.5 GHz band, WCAI, Globalstar, and BAS proponents all argued, *based on worst-case assumptions*, that these services could not operate on a co-channel basis without harmful interference.[8] WCAI said these services "simply cannot exist on a co-channel, co-coverage basis without causing mutually- destructive interference."[9] Globalstar said that BRS power levels would "make it impossible for MSS to operate in the band" as envisioned.[10] And the Society of Broadcast Engineers said co-channel sharing would result in "disastrous co-channel interference."[11]

The Commission disagreed with these worst-case analyses based on practical considerations regarding the actual operational characteristic of S-band systems and typical deployments in the band. Regarding BRS/MSS sharing, the Commission considered the "actual operating conditions of Globalstar's satellite system" rather than a worst-case scenario assuming maximum power flux density levels at all times.[12] The Commission also considered likely usage scenarios and concluded that sharing would be feasible in part

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[8] *See, e.g.,* Petition of Wireless Communications Ass'n Int'l, Inc. for Reconsideration, IB Docket No. 02-364 (filed Sept. 8, 2004) ("WCAI Recon Petition"); Petition for Reconsideration of Globalstar LLC, IB Docket No. 02-364 (filed Sept. 8, 2004) ("Globalstar Recon Petition"); Petition of Society of Broadcast Engineers, Inc. for Reconsideration, IB Docket No. 02-364 (filed Sept. 8, 2004) ("SBE Recon Petition").

[9] WCAI Recon Petition at ii.

[10] Globalstar Recon Petition at iii.

[11] SBE Recon Petition at 5.

[12] *See* Amendment of Parts 1, 21, 73, 74 and 101 of the Commission's Rules to Facilitate the Provision of Fixed and Mobile Broadband Access, Educational and Other Advanced Services in the 2150-2162 and 2500-2690 MHz Bands, *Order on Reconsideration and Fifth Memorandum Opinion and Order and Third Memorandum Opinion and Order and Second Report and Order*, FCC 06-46 at ¶ 32 (2006) ("2006 Order").

because "BRS operations are likely to be in urban, suburban, and somewhat developed rural areas while the greatest demand for CDMA MSS operations is likely to be in very rural and undeveloped areas with little or no existing communications infrastructure."[13] Regarding BRS/BAS sharing, the Commission noted that "there are relatively few BAS facilities operating in the band and this number will not increase."[14] The Commission also found that, "where BRS and BAS operations may coexist, licensees can implement measures to reduce the potential for interference," such as using channels "outside the 2496-2500 MHz band," i.e., using a channel other than A10.[15] The Commission thus concluded that the BAS service need not be relocated merely "to resolve a few difficult sharing cases that may occur."[16]

History has proven the Commission absolutely right.[17] There have been no complaints of interference from EBS/BRS to Globalstar or BAS stations despite the fact that there are millions of 4G EBS/BRS fixed and mobile devices operating nationwide in the U.S. today, including BRS devices operating on a co-channel basis with Globalstar and BAS Channel A10.[18] The lack of any interference, despite the operation of millions of EBS/BRS mobile devices operating in over 70 major markets, including markets in which BRS-1

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[13] In the Matter of Review of the Spectrum Sharing Plan Among Non-Geostationary Satellite Orbit Mobile Satellite Service Systems in the 1.6/2.4 GHz Bands, *Report and Order, Fourth Report and Order and Further Notice of Proposed Rulemaking*, FCC 04-134 at ¶ 72 (2004).

[14] *See* 2006 Order at ¶ 38.

[15] *Id*.

[16] *Id*. at ¶ 40.

[17] In paragraph 10 of its most recent comments in this proceeding, EIBASS cites WCAI's 2004 position on OOBE limits as somehow relevant in this proceeding. *See* EIBASS Comments at 5. But real-world experience with deployed 4G systems has shown that WCAI's 2004 position was wrong.

[18] In its comments, EIBASS notes a single case of interference between a Channel A10 BAS device and an MSS device. EIBASS Comments at 4. The occurrence of a single interference event does not, however, equate to "harmful" interference.

operates on a co-channel basis with Globalstar and BAS, shows that the worst-case interference scenarios envisioned by Globalstar and EIBASS aren't probative in this context. Interference has not occurred – despite dire predictions based on overly pessimistic assumptions – because the real-world operating characteristics of OFDM-based 4G systems almost never approach the interference potential of theoretical models.

If Globalstar's worst-case assumptions are used, the current OOBE limits *already* pose a theoretical risk of interference to Globalstar and BAS from EBS/BRS operations – a theoretical risk that has not proven real. Figure 1 below illustrates the OOBE emissions allowed by the current and proposed Part 27.53(m) rules for a 20 MHz channel bandwidth mobile station, operating at the edge of BRS channel 1, in the frequency range covered by Globalstar's MSS downlink.

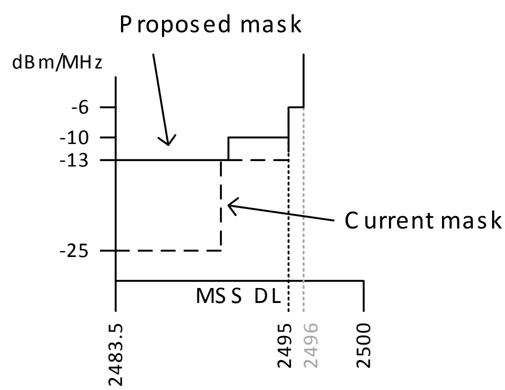

Figure 1: Comparison of current and proposed OOBE limited into Globalstar MSS downlink

Assuming Globalstar channelizes the band, as suggested by their reference to 1.23 MHz integration bandwidths in their technical appendix,[19] then the current rules allow an EBS/BRS mobile station operating above 2496 MHz to emit -25 dBm/MHz (or -24.1 dBm/1.23 MHz) into some MSS channels below 2490.5 MHz and -13 dBm/MHz (or -12.1 dBm/1.23 MHz) into channels above 2490.5 MHz. Applying the 1% $\Delta T/T$ interference level of -133dBm/1.23 MHz used in the technical annex of Globalstar's comments, and allowing for 3dB of polarization loss due to different approaches used in the MSS and BRS/EBS systems (as allowed in Globalstar's analysis), yields a required pathloss of 105.9 dB or 117.9 dB for channels where EBS/BRS mobile station emissions are allowed to be –25 dBm/MHz or -13 dBm/MHz respectively.

To calculate the separation distance that would be required to achieve this loss, Globalstar uses the free space pathloss model in its analysis, which states the pathloss, P_L, in dB, for a given separation, *d*, in meters, is:

$$P_L = 27.56 - 20log_{10}(f) - 20log_{10}(d)$$

where *f* is the carrier frequency in MHz. This yields a value of d = 1.9 km or d = 7.5 km for an MSS station operating in the BRS emission region of -25 dBm/MHz or -13 dBm/MHz, respectively.

So, even under the current EBS/BRS rules, a free space pathloss model suggests that an MSS mobile station would have to be nearly 2 kilometers away from an EBS/BRS mobile station in order to operate in the 2483.5 to 2490.5 MHz range, or 7.5 km away to operate in the 2490.5 to 2495 MHz range. These results suggest that Globalstar's MSS system and 4G

[19] *See* Globalstar Comments.

EBS/BRS mobile services should not be able to coexist today. But they *do* coexist without incident. The separation distances provided by a free space pathloss model are thus of little use in predicting the real-world potential for interference between EBS/BRS and Globalstar's MSS and BAS as well.

There are a number of reasons why the proposed OOBE limits would not actually cause harmful interference as predicted by a free space pathloss model. First, the Commission's previous findings regarding the nature of these services are still valid and equally applicable to the OOBE limits proposed in the NPRM. BRS/EBS does not typically operate in the very rural locations where Globalstar's MSS operations are most likely to occur, and there are few BAS stations using Channels A9 and A10. As of July 25, 1985, the Commission grandfathered existing BAS stations and ceased accepting applications for new or even modified BAS stations in the 2483.5-2500 MHz band (where channel A10 operates).[20] According to the Commission, as of 2006, there were only 89 BAS stations operating in this band[21] (and our research indicates there are now even fewer active licenses). There are likewise a very limited number of stations operating on Channel A9 (there appear to be approximately 500 active licenses).[22] The actual usage of these services thus mitigates the potential for interference.

Second, 4G EBS/BRS mobile stations rarely operate in accordance with worst-case interference scenarios. The probability that a 4G EBS/BRS mobile station would operate at full transmit power across an entire channel, all of the time, in areas without any pathloss is close to nil. 4G mobile stations prioritize the preservation of battery life and hence utilize

[20] *See* 2006 Order at ¶ 35.

[21] *Id*.

[22] Channel A9 is located in the 2467–2483.5 MHz band. *See* 47 C.F.R. § 74.602.

power control to minimize transmission power at all times. Thus, for mobile stations, the worst-case scenario typically occurs when the mobile station is located indoors and building penetration losses need to be overcome in order to communicate with a distant outdoor base station. When a 4G EBS/BRS mobile station is operating "on-street," it can be expected that it will be operating far from maximum power, and thus OOBE will be significantly reduced (as OOBE is generally caused by non-linearity in the transmit chain, even a small reduction in transmit power can cause a large reduction in OOBE). Even if a 4G EBS/BRS mobile station is operating "on-street" in cell edge conditions, where it could be operating at full power, the mobile station would need to limit the bandwidth of transmission in order to maximize power spectral density. This limits the instantaneous bandwidth that is typically used at full power, which in turn limits out of band emissions. Because this cell-edge user would likely be sharing the uplink channel with many other users, the cell edge user would also not be transmitting all of the time. It is thus unlikely that an "on-street" 4G EBS/BRS mobile station close to the continuous area of 4G service coverage will be occupying the entire bandwidth of the uplink channel while also transmitting full duty cycle at full power. Conversely, when a 4G mobile station is in "good channel conditions," it will likely have low pathloss to multiple serving base stations and will not be operating at full transmit power. For these reasons, use cases such as those presented by EIBASS[23] regarding the effect of a 4G mobile handset operating from an observation platform near the top of a high rise building are not valid.

[23] EIBASS Comments at 3.

Globalstar expresses concern about multiple mobile stations operating in the same vicinity. As previously noted by WCAI,[24] the actual OOBE is a function of transmitter non-linearity's which may occur in the case of an individual 4G mobile station, depending on the power allocated and the number and location of the allocated frequency resources to that user of the OFDMA base station to which it is connected. BRS/EBS mobile stations operating in the same vicinity are typically communicating with the same base station, which means that its OFDMA channel resources must be multiplexed in frequency and/or time among the mobile stations. In this situation, because OFDMA is based on each user being allocated "orthogonal" resources, none of the individual mobile 4G mobiles would ever have an opportunity use the entire channel, all of the time, with full power allocation, and thus would not be at risk for producing harmful OOBE. As a consequence, for systems based on allocation of orthogonal resources it cannot be assumed that the emissions will simply grow proportionally with density of operational devices.

Moreover, due to the typical street level clutter in the urban and suburban environments in which EBS/BRS mobiles typically operate, the probability of there being perfect line-of-sight between a 4G EBS/BRS mobile station and a Globalstar MSS DL receiver or BAS device (as assumed by a free space pathloss model) is very unlikely over distances of more than a few hundred feet. Although there are no widely acknowledged propagation models for such conditions – particularly in the 2.5 GHz band, where both the transmitter and receiver antenna are typically close to ground level – standard models for base station to mobile station pathloss in suburban and urban environments are

[24] Comments of WCAI, WT Docket No. 03-66 (filed July 7, 2011) ("WCAI Comments").

instructive. The 3GPP technical report 36.942[25] provides a mobile station to base station pathloss model in the suburban and urban environment when line-of-sight is not present. The model defines pathloss in that environment as:

$$L = 40 \cdot (1 - 4 \cdot 10^{-3} \cdot Dhb) \cdot \log_{10}(R) - 18 \cdot \log_{10}(Dhb) + 21 \cdot \log_{10}(f) + 80dB$$

where *Dhb* is the height of the base station antenna in meters, *R* is the mobile to base station separation in kilometers, and *f* is the frequency of operation. Solving *R* for pathloss values of 105.9 dB and 117.9 dB, as would be required between a BRS/EBS mobile station and an MSS mobile station, yields a separation distance of 190 and 395 meters, respectively, for a base station antenna height of 10 meters.

Those distances are significantly shorter than the distances produced by Globalstar in its free space pathloss analysis. They are also significantly more realistic than free space pathloss distances, yet separation distances of 190/395 meters are still too pessimistic. BRS/EBS to MSS mobile station pathloss attenuation will typically be greater than that of the EBS/BRS mobile station to its serving base station – and the resulting separation distances even shorter – because the MSS antenna will typically be at a lower elevation than an EBS/BRS base station.

Globalstar's analysis also appears pessimistic in equating a 1% $\Delta T/T$ rise in the effective noise floor with an outage or loss of service. Although we do not know the specifics of the sensitivity of MSS DL receivers, such a small tolerance does not appear very workable in a practical system. It seems more reasonable that Globalstar's MSS system

[25] The referenced equation is taken from section 4.5.2 "Macro cell propagation model – Urban Area" of 3GPP TR 36.942 v10.1.0 (2010-09), which is available at www.3gpp.org, and is quoted as being valid for scenarios in urban and suburban areas outside the high-rise core.

would start to suffer some graceful degradation in service as the noise level rises above 1% $\Delta T/T$.

In sum, given the nature of services in the band and the reality of how 4G mobile stations based on OFDMA operate, the proposed rules would not cause a noticeable impact to current or future MSS DL or BAS operations. For interference to occur, devices would have to be relatively close to each other, at the edge of BRS/EBS service area, and the BRS/EBS mobile device would have to be transmitting 100% of the time across all the bandwidth of the BRS/EBS channel, while receiving maximum power allocation from its serving base station. As noted above, the probability of this combination of events occurring is extremely low. In the unlikely event that interference occurs, Globalstar or BAS operators may submit a documented interference complaint pursuant to Rule 27.53(m)(4) to remedy the issue.

c. The proposed rules would not result in harmful interference to services within the 2.5 GHz band.

IPWireless expresses concern that the amended rules would cause interference within the 2.5 GHz band due to the possibility of uncoordinated TDD systems or the coexistence of TDD/FDD systems.[26] IPWireless further claims that "the proposed emissions mask relaxation is likely to reduce spectral efficiency through forcing licensees to implement guard bands to avoid interference between uncoordinated TDD systems."[27]

WCAI has provided considerable technical material[28] covering 4G standards, OFDMA system design, and use case analysis of real-world 4G device behavior

[26] Comments of IPWireless, Inc., WT Docket No. 03-66 (filed July 7, 2011) ("IPWireless Comments").

[27] *Id* at 2.

[28] WCAI Comments at 1, 6.

demonstrating that *any* increased interference under the new proposal is highly improbable. Numerous comments from 4G operators and equipment vendors, including world leading manufacturers of 3G, and 4G user device terminals/chipsets, support WCAI's position. Motorola Mobility Inc. has included a summary of LTE simulations by 3GPP that shows the likelihood of interference actually occurring is very small, and they conclude that any interference concerns are merely hypothetical.[29]

There are numerous flaws with the IPWireless claims about unsynchronized systems and guard bands. First, the potential for interference among uncoordinated TDD systems and TDD/FDD systems is already present in the band. Indeed, these interference scenarios have been an inherent feature of the band since its inception based on the Commission's preference to make the band "as flexible as possible."[30] The Commission noted the "inherent tension between the dual objectives of affording licensee's flexibility and grouping like systems together."[31] To resolve these tensions while providing maximum flexibility, the Commission provided mechanisms for resolving documented interference events.[32] To further enhance system coordination in the BRS/EBS band, WCAI has developed best practices (i.e., a synchronization plan, coordination matrix, and center frequency standards) for licensees to promote system coordination.[33] These mechanisms have been implemented and a variety of educational, broadcast, and commercial fixed and

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[29] Motorola Comments at 2.

[30] In the Matter of Amendment of Parts 1, 21, 73, 74 and 101 of the Commission's Rule to Facilitate the Provision of Fixed and Mobile Broadband Access, Educational and Other Advanced Services in the 2150-2162 and 2500-2690 MHz Bands, *Report and Order and Further Notice of Proposed Rulemaking,* FCC 04-135 at ¶ 132 (2004).

[31] *Id* at n. 226.

[32] *See* 47 C.F.R. §§ 27.53(m)(2), (4).

[33] *See* http://www.wcai.com/best-practices.html.

mobile broadband services successfully co-exist in the band today. The Commission's rules and industry best practices thus address already the concerns of IPWireless.

Next, as a technical basis for their position, IPWireless refers to CEPT Report 19, which documents 5 MHz guard channels as one of several interference mitigation techniques for unsynchronized systems. CEPT Report 19 focuses only on 5 MHz channel bandwidths in the context of unsynchronized UMTS/IMT-2000 (3G) systems whereas this NPRM addresses 4G/IMT-Advanced systems using channel bandwidths of 20 MHz and larger using OFDMA technology. The WiMAX Forum has designated 2496-2690 MHz as band class 3.A,[34] which has been a primary band for global WiMAX deployments since 2005. Similarly, the 3GPP has defined three band class specifications for 2496-2690 MHz (bands 7, 38, and 41).[35] Spectrum for these bands has been allocated in numerous regions around the world, and there are commercial LTE deployments using these bands. All of these band definitions prevent the risk of unsynchronized interference that IPWireless has chosen to highlight, yet the mobile device specifications from WiMAX Forum and 3GPP and the global spectrum allocations for these bands have not adopted the recommendations from CEPT Report 19. The CEPT Report 19 technical foundation upon which IPWireless relies is thus inapplicable to 4G/IMT-Advanced systems based on OFDMA technology and has not been adopted by any of the 4G standards organizations.

IPWireless also asserts that the amendment isn't necessary because IPWireless has produced a mobile device that meets the current OOBE limits while supporting a 20 MHz channel. This claim ignores the fact that most of the world's leading manufacturers of

[34] *See* WMF-T23-005-R015v04 (available at www.wimaxforum.org).

[35] *See* 3GPP TS36.101 (available at www.3gpp.org).

mobile devices collaborated to develop the 3GPP LTE specification that defines the mobile emissions mask for the 2.5 GHz band,[36] and they agreed that the mask proposed in the Petition represents an appropriate and reasonable trade-off between form factor, battery consumption, and performance, especially for the most challenging type of device: highly integrated smartphones with multiple radios. As noted above, many of these manufacturers have submitted comments supporting the Petition.

Although individual manufacturers may be able to outperform the minimum requirements specified in the 3GPP standard in some circumstances, battery-powered devices will often be unable to outperform the mask with 20 MHz channels while retaining their essential characteristics (*i.e.*, appropriate form factor, battery consumption, and performance). The existence of IPWireless's USB device does not disprove this point.

As noted previously by WCAI,[37] the NPRM is primarily targeting the most challenging type of device: highly mobile, highly integrated, multi-mode, multi-band smartphones with 2G/3G/4G functions. IPWireless has provided pictures of a single-mode LTE USB device which they claim supports LTE Band 38 using 20 MHz channels that is 3GPP compliant and meets FCC Commission's current OOBE specifications. But the IPWireless USB device does not belong to the class of devices primarily targeted by this NPRM. Even if it did, IPWireless has neither provided technical data by which its claims may be evaluated, nor data showing whether its device meets the 4G system design criteria that is critical for commercial viability – specifications such as transmit power output, total power consumption, current draw, thermal ratings, emissions measurements, and

[36] *See id*.

[37] WCAI Comments at 1, 6.

standards conformance test results.

Finally, the IPWireless USB device supports only Band 38 for the 2.5 GHz band. Band 38 only covers 2570-2620 MHz, or 50 MHz of usable bandwidth in the midband (MBS). The EBS/BRS band covers 2496-2690 MHz, which is 194 MHz of bandwidth. Since OOBE performance is inherently a function of bandwidth, power and transmitter linearity, a narrowband device that operates only in the MBS channels may enjoy a significant performance benefit over devices that target the full 194 MHz of bandwidth. A fundamental tenet of any mobile cellular system design is that mobile devices will continuously roam among base stations that are operating at different discrete channels within the entire operating band. A 4G mobile device that does not cover the full EBS/BRS band would not be able to meet this basic requirement and is out of scope for this discussion.

IPWireless also mentions that they previously provided detailed technical evidence, including emission measurements of commercially supplied mobile devices. Unfortunately, the data they provided does not address all relevant considerations. In order to demonstrate this, simulations produced by device vendors and input into the 3GPP process that resulted in the final mobile device radio specifications can be referred to in order to show how typical emissions may look, given different types of allocation on the uplink, and under real world operating conditions (i.e. largest manufacturing tolerances, extreme temperature conditions, etc.). Figure 2 shows such simulations below,[38] illustrating the various emissions that may result under a range of operating conditions for different resource block ("RB") allocations on the uplink. A resource block is the term used in LTE to

[38] These simulations are taken from 3GPP contribution R4-071623 to RAN Working Group 4 during the early stages of development of the LTE UE radio specification (available at ftp.3gpp.org).

describe the minimum unit of allocation in the frequency domain. On the uplink a resource block is comprised of a number of adjacent OFDM subcarriers. Multiple resource blocks may be concatenated to increase uplink data rate. In the figure, the red line shows the proposed mask and the other lines illustrate emissions results associated with various amounts of OFDMA uplink RB allocations.

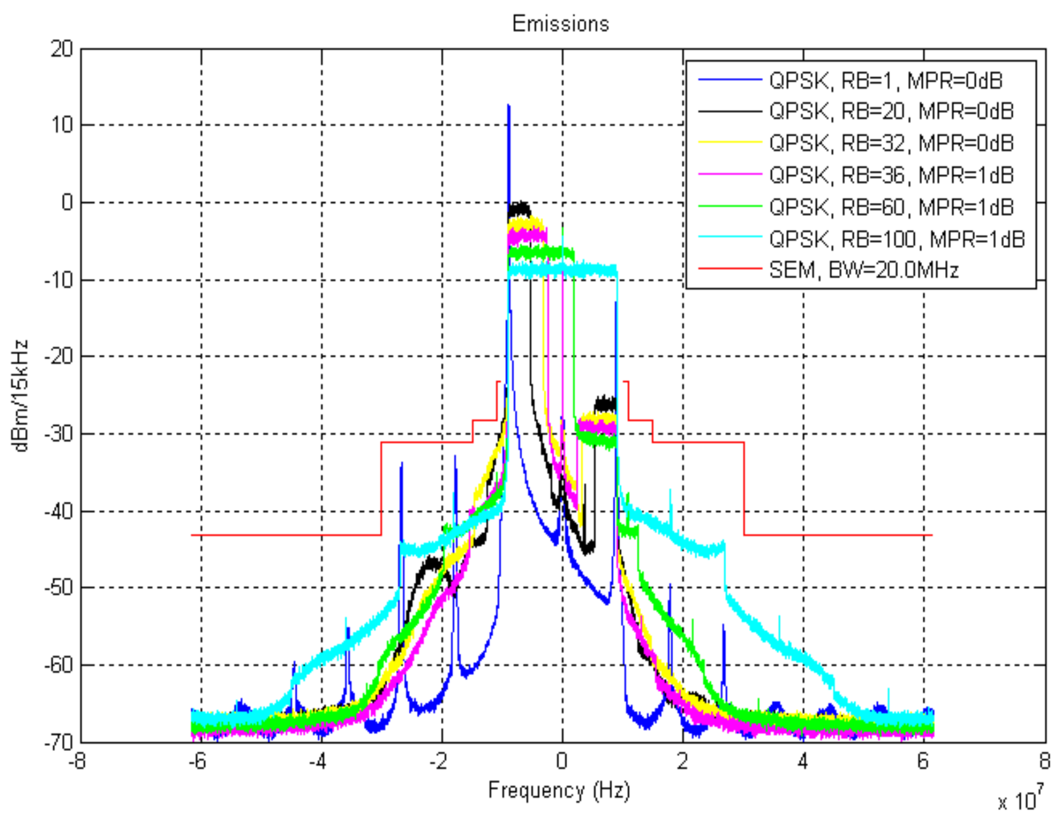

Figure 2. Simulation of LTE uplink spectral emissions for 20MHz channel

The results for the case of full RB allocation (i.e. RB=100) show significant margin to the mask, which is in line with the claims provided by IPWireless. For example at 10MHz from the channel edge, the emissions in Figure 1 are of the order of -45dBm/15 kHz, which is equivalent -26.8dBm/MHz. This compares to approximately -30dBm/MHz in the

IPWireless results. However, due to the nature of the uplink in LTE, when one resource block is allocated right at the channel edge, then third order intermodulation products between the wanted and image signals can cause narrowband spurs to occur that approach the mask limit. 3GPP specified the mask so that in the case of such narrowband spurs, the mask will be met. Similar spurs will occur in different locations if small RB allocations are made at other locations near to the channel edge, where the exact location will be based on the third, and possibly fifth, order intermodulation products of the wanted signal with the image and local oscillator leakage.

It is worth noting from the simulation results in Figure 2 that all of the various allocations shown on their own fall well under the 3GPP mask, in that the total integrated out of band power of any of the RB allocations shown is generally much less than that allowed by the mask. As a result the mask is not representative of the emissions from any one mobile station; instead it is an envelope under which any instantaneous emission will be guaranteed to fall. Therefore it is not appropriate to simply assert that the proposed change to the emissions mask will result in an increased level of interference; the proposed rules changes are intended to simply enable deployment of 3GPP compliant mobile devices that utilize Single Carrier Frequency Division Multiple Access[39] ("SC-FDMA") on the uplink in order to maximize battery performance, and hence exhibit the resource allocation specific emissions properties illustrated in Figure 2.

IPWireless has produced one-off results, with no consideration of mobile device performance under different uplink allocation types, no indication of how thermal

[39] Note that SC-FDMA is a special multiple access form of OFDM, and is sometimes referred to as DFTS-OFDMA

operating conditions or manufacturing tolerances may affect the results, and no indication of device architecture. Further, they do not provide any consideration of the intermodulation products that can occur when small RB allocations are made close to the edge of the OFDM channel. It is worth noting that such allocations occur continually when a device is transmitting uplink control information on LTE's Physical Uplink Control Channel ("PUCCH"), which is often located in the channel edge RBs in order to maximize frequency diversity.

While individual manufacturers may be able to outperform the minimum requirements specified in the 3GPP specifications, and this is more than expected for some device types, it is likely that there will be some devices that, on occasion, will only meet certain regions of the mask. On the contrary, mobile network operators typically design their networks under a broad cross section of assumptions that must account for all types of mobile device implementations. As the Telecommunications Industry Association ("TIA") noted in its comments, "[t]he existence of some mobile devices capable of operating on 20 megahertz channels and meeting the current FCC OOBE rules should not undercut the necessity of these rule changes. . . . Without making the proposed changes, some devices that use 20 MHz channels will not be able to meet existing OOBE requirements."[40] IPWireless's concern is thus irrelevant to the concern WCAI's Petition is attempting to address, which is the difficulty of meeting the Commission's current OOBE limits in all types of devices while enjoying worldwide economies of scale.

[40] TIA Comments at 2.

III. Conclusion

The majority of commenters agreed that amending the OOBE limits as proposed in the NPRM would facilitate the rapid deployment of 4G mobile broadband services in the 2.5 GHz band nationwide. WCAI therefore requests that the Commission adopt the rules as proposed.

Respectfully submitted,

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